Utilization of Personal Protective Equipment and Associated Factors among Building Construction Workers in Addis Ababa, Ethiopia 2019

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Abstract

Background

Personal Protective Equipment (PPE) is a material, device, equipment or clothing which is used or worn by a worker to protect them from exposure or contact with any harmful material or energy which may cause injury, disease or even death. The use of personal protective equipment is a universal legal requirement to protect workers against occupational injuries and illnesses in their workplace. The international labor office estimates that every year there are some 125 million work-related accidents, 220, 000 of them are fatal. This study assessed personal protective equipment utilization and associated factors among building construction workers in Addis Ababa, Ethiopia 2019.

Methods

Institution based cross-sectional survey was conducted on the selected construction sites in April 2019. Data was collected by using pre-tested Amharic questioner from 206 study subjects with a response rate of 100% via face to face interviews. Epi info version 7.1 and SPSS version 25 were used for data cleaning and analysis respectively. Independent variables with $P < 0.2$ were transformed from bivariate to multivariate logistic regression. $P < 0.05$ and was declared as an associated factor.

Results

This study showed that (38.3%) of construction site workers were used at least one personal protective equipment. Presence of safety training, safety brief before commencing work and the availability of governmental visits were associated factors for utilization of personal protective equipment. Regarding, the type of injuries that occur on a majority of workers were abrasion (35%) and climbing at high was the common cause of injury.

Conclusions

PPE utilization and safety measure in construction industries is insignificant and construction site workers are not adapted to take care of themselves as it manifested by low use of PPE. An effort for occupational safety assurance should be put in practice to avoid accidents on building a site with an unconditional commitment to all the projects. Riddance of hazards and deterrence of accidents on-site should be within the proficiency of each site. The client should be involved in safety management coupled with having a great craving for safety.

Background

Personal Protective Equipment (PPE) is any material, device or clothing like gloves, helmets, goggles, hard shoes which are used or worn by a worker to protect them from exposure or contact with any harmful material or energy which may cause injury, disease or even death to the worker⁽¹⁾

Building construction is a complex sector that has very different hazards, like work at heights, work with power tools, working in the outdoor elements, lack of standards or regulations among workers in terms of expertise in

their trade and training standards, low access in equipment's, less regulation and leadership , less safety culture, unclear communication, and enforcement than other sectors. (2)

The World Health Organization defines occupational injury as an epidemic problem in the field of public health in developing countries. The human suffering caused by the injuries is hurtful to the employee, the employer and society According to the International Labor Organization 270 million occupational accidents are causing 2 million deaths annually (3).

The use of PPE is a universal and legal requirement to protect workers against occupational injuries emergence of hazardous or harmful agents and illnesses in their workplace. These personalized items are very useful, as, without them, workers could be exposed to a variety of toxic substances, chemicals, radiation, or incidents, which could result in occupational diseases, injuries, or even fatalities. Among the construction industry, 90.1% of accidents of fatality cases are preventive(4).

Injuries related to construction work remain a serious problem worldwide. The International Labor Office (ILO) estimates that every year there are some 125 million work-related accidents, 220000 of them fatal. According to WHO, 160 million new cases of occupational diseases are caused annually by exposure and dangerous conditions at the workplace; 30-40% of them can be expected to lead to chronic diseases and about 10% are likely to result in permanent disability (5,6).

OSHA standard 1910.132 explains the General Requirements for employers to assess and determine workplace hazards. PPE must properly fit each affected employee and the hazard assessment must be "certified" as such, in writing. Damaged or defective equipment must never be used in the workplace. Employees must understand when it is necessary to use PPE, what equipment is required, how to use or wear it, how to care for it, how to know when the equipment has reached the end of its useful life and how to dispose of PPE (7).

Even if the prevalence of specific worksite injury is not known in Ethiopia due to lack of specifically documented data it is terrible for workers and Emergency health care professionals. The impact of occupational health and safety hazards faced by construction workers in developing countries is 10 to 20 times higher than those in Industrialized countries (8). Workers in the construction sector are more exposed to physical psychological, biological and chemical risk factors(9).

Safety issues in the construction industry of the developing world receive inadequate attention and provision. It does not get a greater priority, this prevails for many reasons like owing to cost, lack of enforcement and ignorance of the stakeholders (10).

Occupational injuries pose major public health and developmental problems; which result in serious health, social and economic consequences on workers and their employers(5). The probability of fatality in the construction industry is five times more likely than in the manufacturing industry(11).

PPE utilization is one of the recommending action for workers to protect from job site injury. Countries on the way of construction like Ethiopia needs a healthy and motivated working group. Identifying the gap on PPE utilization uses for any responsible body to act upon it on the area of occupational safety.

Methods

Study Area and Period

The study was conducted in Addis Ababa construction sites which has direct regulatory communication with Addis Ababa city administration construction office. Addis Ababa is the capital and largest city of Ethiopia and a head seat for the African Union, set for more than 92 embassies and consular representatives, international agencies. It is also the country's commercial, industrial, and cultural center found in central Ethiopia with an elevation of about 2440 m. above sea level on a plateau that is crossed by numerous streams and surrounded by hills. In Addis Ababa, there are more than 2800 registered construction companies that are regulated by the government and authorized PLCs (5). This study includes only construction companies that have direct regulation with Addis Ababa construction office during the study period from April to May 2019.

Study Design

Institutional based Cross-sectional study design was conducted at selected construction sites.

Source Population

All construction workers in Addis Ababa

Study Population

Workers who were directly involved in the building construction and who fulfill eligibility criteria.

Study Subjects and Study Unit

Workers who were directly engaged in building construction work during the data collection period by using payroll or attendance sheets.

Inclusion Criteria

Construction workers at selected organization sites who are actively participating in daily routine construction work and stay more than one day.

Exclusion Criteria

Administrative staff, field supervisors, other supportive staff, workers who stay less than one day and who are on sick leave are excluded from the study.

Sample Size Determination

The lottery method was used to select construction sites to form all construction sites regulated by the Addis Ababa construction office. Dagmawi Minilik eye center, Bole hospital, Tegbareed TVET, Meless Academic, and Lideta police construction sites workers were got chance.

Sampling Procedure

The survey was done from workers at selected construction sites based on eligibility criteria for the interview by using the payroll/attendant sheet as a sampling frame (Fig 1).

Study Variables

Dependent Variable

Utilization of personal protective equipment.

Independent Variable

Age; Sex; Educational Level; Work Experience; Availability of Material; Awareness; perception of injury and Supervision.

Data Collection Technique and Instrument

Data were collected by using pretested and structured Amharic questionnaires via face to face interviews. Questionnaires include socio-demographic, behavioral, and environmental factors that affect PPE utilization within the construction area. Data was collected by six BSc health professionals and two supervisors from MSC candidates. Training and clarification was given for all data collectors and supervisors. Additionally, the principal investigator was involved in solving ambiguities and making further clarifications on the spot.

Data Quality Assurance

To assure data quality pre-testing of the questionnaire was done by 5% of the total sample size at the construction site at Akaki TVET construction site. Data entry had been done by Epi Info on daily bases, there were proper categorization and coding of the data including timely checking of the completeness of questionnaires during data collection. PI was engaged in follow up and checking the completeness of questionnaires through the overall data collection period.

Data Entry Processing and Analysis

Data were checked for completeness, inconsistencies, cleaned, coded. Then the collected data were entered into Epi info version 7.1 and exported to SPSS version 25 for statistical analysis. Univariate analysis was done at a 20% level of significance to screen out potentially significant independent variables. The association between the dependent and independent variables was analyzed using a binary logistic regression model. Those variables in bivariate analysis whose p-value less than 0.20 were included in multivariate logistic regression for not to miss associated factors. Then multivariate analysis was computed for those factors that showed a statistically significant association in bivariate analysis to identify factors that independently influence the occurrence of dependent variables and Finally, variables whose p-value less than 0.05 ($p < 0.05$) in the logistic regression were considered as statistically significant association and they were interpreted by using their adjusted odds ratio.

The output of descriptive statistics was reported by percent, pie chart and graphs to summarize data.

Dissemination of Research Finding

The result of the study will present to the AAU emergency medicine department, will report to the Ethiopian society of emergency professionals, ministry of labor. The finding the study will present at scientific conferences and effort will have to publish in relevant scientific and popular journals.

Operational Definition of Terms

Personal Protective Equipment – Any material, device, equipment or clothing which is used or worn by a worker to protect them from exposure or contact with any harmful material or energy which may cause injury, disease or even death to the worker.

Utilization – The use of PPE consistently and appropriately to prevent injuries and illness.

Occupational Health – A cross-disciplinary area concerned with protecting the safety, health, and welfare of people engaged in work or employment. The goal of all occupational health and safety programs is to foster a safe work environment.

Occupational Injuries – These are any physical injuries resulting from an occupational accident at the workplace.

Risk – is the likelihood that a person may be harmed or suffers adverse health effects if exposed to a hazard at the workplace.

Results

Socio-demographic characteristics

A total of 206 respondents were included for the interview and all the respondents completely responded to the questioner with a response rate of 100%.

Among the respondents (76.2%) were male. The mean age of respondents was 25.5 (SD $\pm$ 4.07). The majority of respondents were below 30 years (88.3%). The study also showed that (59.2%) were single. Regarding educational status (30.1%) of the respondents were illiterate. The majority (59.7%) participants had work experience of less than one year and work duration was 7-8 hours [162(78.6%)]. For (71.4%) of workers the recruiting system was the temporary base (table 1).

Status of PPE Utilization

The finding of this study showed that (38.3%) of participants had used any personal protective equipment (fig.2).

Reasons for Not Utilizing PPE

This research had shown various types of reasons why construction workers did not use PPEs in their workplace. Of which (30.6%) were responded PPE not available, 34(21.3%) were no information for using (fig 3).

Pressure for Using PPE

Based on the response obtained regarding enforcement or supervision on PPE utilization (82.5%) of participants were do not remember anybody who enforce or supervise them regarding PPE use (fig 4).

Awareness of Construction Workers On Cause of Hazards and Injuries

According to our finding climbing at high was the major (25.9%) cause of injury followed by dust /fugs (22.7%). The study indicates the presence of multiple causes (fig.5).

Type Injuries Perceived and Suffered by Construction Workers

Our study identified that the most commonly perceived type of injury was abrasion by 35.3% and 2% of them were perceived permanent disability. In another way, 32.2% was suffered abrasion and 5.6% was suffered by back pain while they were at work site. Multiple causes of injury and more than one perception were identified (Table 2).

Preparedness for Injury Prevention

In this study preparation for protection of injury was tried to assess by variables like knowing any type of PPE, the presence of safety training and safety brief before commencing actual work. Based on this finding 84.5% of participants can call at least one PPE (table 3).

Factors Associated with PPE Utilization

Independent variables like age, level of education, the term of employment, year of experience, availability of safety training, PPE utilization training, perception of injury, knowledge on PPE, safety brief before commencing work and availability of enforcement or pressure to use PPE was tested by binary logistic regression.

Variables with a P value of less than 0.2 during the bivariate analysis were included in the multivariate logistic regression. Among them, Safety Training, PPE use training, safety brief before commencing work and governmental visit showed association with PPE utilization. Those who took general safety training on PPE use were about 2 times more likely to use personal protective equipment [AOR CI 95% 2.343(1.084,5.062)] than those who does not took training, those who had safety brief before commencing work were About 4 times more likely to use personal protective equipment (AOR [95% CI 4.156(1.921,8.988)], those who had PPE use training are 4.8 times more likely to use PPE [AOR CI (95%) 4.821(2.263,10.272)] and workers who are pressurized or supervision by anybody were 5 times more likely to use PPE [AOR CI 95% 5.04(1.938,13.106)] than who did not (table 4).

Discussion

Our result confirmed that only 38 % of workers have been using at least one PPE material while they are working. This finding is parallel with a study done in Saudi Arabia 12% of the participants used PPE all the time while. Another study in Kampala, Uganda, showed low use of PPE which is 15.6% among building construction workers. An observational study done in Ethiopia among Addis Ababa condominium construction sites 96.8% of workers were not using PPE all the time while they are on duty, but ILO recommendation is 100% safety wear for all industry workers (5,33). This gap might be due to poor knowledge, lack of PPE materials, using stimulant substances, unavailability of safety alerts and enforcements. The raised result for this study than the previous one may be due to the difference in methodologies and the presence of minimum public awareness and increment injury perception.

In this study, we have shown that the reasons for not using PPE were unavailability of material (30.6%), lack of information to use PPE (31.3%) and PPE materials are not comfortable to use (16.3%). This is in line with this a study was done in Nigeria showed that the reason for not using PPE was uncomfortable, oversized/undersized, not designed for hot and cold weather and heaviness. In another similar study, the reason for not using PPE was lack of access to materials (93.5%), discomfort and results in work delay (6.5%) (34). Such types of reasons

might be due to lack of interest and awareness from workers, lack of concern from responsible bodies, lack of comfort and advanced PPE materials, prioritizing money than safety from construction companies

In this study, we have found that the leading worksite injuries were abrasion (38.8%). followed by piercing /cut (32.2%) and puncture (21.0 %). In a similar study done in Addis Ababa condominium site workers the common injury was hand injury (11.3%), back pain (9.7%) this shows that using at least minimum available PPE material for not exposing body can reduce the majority of injuries.

In our finding the identified common cause of injury was climbing at high (25.9%), dust/fug (22.7%). In a similar study done in Addis Ababa condominium site workers, the common cause was lifting heavy objects (8.1%)(3). This may be due poor working environment, nonprofessional workers, using old climbing materials, using woods and local materials to construct bridge around slab and waiting locally constructed climbing materials for long period of time so it affected by seasonal variations, heavy lifting, lack of concern from designers for possible cause of injuries, limited working space, excessive workload, and untrained workforce.

In this study, we provide evidence that unavailability of safety training, lack of PPE utilization training, lack of safety briefing before commencing work and nonexistence of enforcement were significant factors of PPE utilization. This is an equivalent result with research done in Nigeria, supervision is needed so that a supervisor should be appointed to ensure compliance. while Several measures and punishments should be meted out to contractors who violate safety policy (35). This could be due to negligence of safety issue from responsible bodies, lack of external pressure for worker's sake, nonexistence of safety-related obligation for construction license, shortage of engineering control and hazard notification from designers, deficiency of workers control from managers, lack of conducive environment including ineffective communication between managers (kabos) on forming of suitable working condition and health and safety lack of implementing safety policies.

This result also shows monitoring and supervision regarding construction site safety are low. Even though; studies and acts declared that each contracting company should ensure continuous monitoring and supervision. It is also supported by Ethiopian Labor Proclamation No 377/06 in Article 92 and ILO code of conduct (14,36) since it clearly spells out the fundamental obligations of an employer with regard to putting in place of all the necessary measures in order to ensure, workplaces are safe, healthy and free of any danger to the well-being of workers. unavailability of monitoring and supervision is a lack of concern from responsible bodies.

In this study, the odds of PPE utilization among workers who had enforcement were about five times high when compared to those who did not. The reason behind this could be that fear of punishment or seeking award.

In the case of most of Addis Ababa construction sites consultants who are directly engaged in the qualified construction industry got working authorization from Addis Ababa city housing and construction authority by gratifying the outlined necessities. But in the requirements, nothing is expected from these firms concerning Occupational safety and hygiene. On the contrary on Ethiopian labor, proclamation employer is obliged to take measures to safeguard the health and safety of the workers; Moreover, the proclamation ensure that workers are properly instructed and notified concerning the hazards of their respective occupations and the precautions necessary to avoid accident & injury to health. Directive is given and also assign safety officer, establishes an occupational, safety and health committee, provides workers with protective equipment, clothing, and other materials and instruct them of its use, obliged to register and notify to the nearest labor inspection services occupational accident and diseases(1,18). This is not practical in the study site.

Safety training and PPE use training increase PPE utilization by about 2 and 4 odds in sequence. It shows that the majority of workers has lack information and poor in technical but easy actions.

Even though it doesn't show association with PPE utilization of female sex, age greater than 30 and workers who previously experience injury have better utilization of PPE than others. This may be due to males are self-exposed and defendant in nature, age greater than 30 may get a lesson from experience and workers who sustain injury previously may learn from the action and it is the raise of action taking for a reaction happening by identifying solution PPE as a means of solution.

Conclusions

This study has declared only 38 % of workers have been using at least one type of PPE. The majority of respondents mention different reasons for not using PPE on their working site those are unavailability of material by, lack of information to use PPE and PPE materials are not comfortable to use.

In this study, we identify the leading worksite injuries and the causes of injuries. abrasion and piercing /cut were the common type of injury and clamping at high and dust/fug are common reasons.

This study also delivers hint for predictors influencing PPE utilization which includes unavailability of safety training, training on PPE use, lack of safety brief before commencing work and absence of enforcement.

This result can use as a pioneer for occupational and safety-related institutions and used for strengthening workers' safety to improve the productivity of manufacturing industries

Strength And Limitations Of The Study

STRENGTH OF THE STUDY

- Since there was no study done on PPE utilization and associated factor among building construction workers the finding will serve as baseline information for further research and important for policymakers to design strategy to prevent and control occupational injury.
- Using face interview during data collection reduces nonresponse rate, permit clarification of questionnaires and addressing all participants without educational status.
- This finding spreads new sight for emergency care health professionals on occupational safety from different eclectic views of perspectives including the legal, social and conceptual views of safety requirements.

LIMITATIONS OF THE STUDY

- Across-sectional study design could result in recall bias and a point in time survey so to assess in detail including practice better to use observational study
- Lack of similar studies particularly in Ethiopia made difficult in comparing results
- minor but sever cases are not identified due to the methodology and sample size.

Abbreviations

AAU: Addis Ababa University; DOSHS: Director of Occupational Safety and Health Association; EDHS: Ethiopian Demographic Health Survey; ILO: International Labour Organization; OSHA: Occupational Safety and Health Association; PPE: Personal Protective Equipment; UN: United Nation; WHO: World Health Organization

Declarations

Ethics approval and consent to participate

Ethical clearance was taken from AAU emergency medicine ethical review committees. A formal permission letter was obtained from the city government of the Addis Ababa Construction office before data collection for each study site. Informed consent was taken after a clear description of the objectives of the study and its procedures for participants before proceeding data collection.

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

Availability of data and materials

The data that support the findings of this study are available from the corresponding authors upon reasonable request.

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Authors' contributions

MY and AA were involved in the conception, design, analysis, interpretation, report and manuscript writing. AKA and SK were involved in the design, analysis, interpretation and report writing. All authors read and approved the final manuscript.

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Tables

Table 1: Selected socio-demographic characteristics participants on PPE utilization and associated factor among construction workers in Addis Ababa, Ethiopia 2019.

Variable		Frequency	Percent
Sex	Male	157	76.2
	Female	49	23.8
Age	<=30	182	88.3
	>30	24	11.7
Marital status	Married	81	39.3
	Single	122	39.2
	Divorced	3	1.5
Working Hour	< than 5 hour	7	3.4
	5-6 hour	7	3.4
	7-8 hour	162	78.6
	9-10 hour	19	9.2
	11-12 hour	11	5.3
	1 day to 1 year	123	59.7
working Experience	1 to 5 year	63	30.6
	6 to 10 years	15	7.3
	10 and above	5	2.4
Term of employment	Permanent	59	28.6
	Temporary	147	71.4
Level of Education	Illiterate	62	30.1
	Primary	54	26.2
	Secondary	49	23.8
	Above college	41	19.9

Table 2: *Type of injuries perceived and suffered by construction workers on PPE utilization and associated factor among construction workers in Addis Ababa, Ethiopia 2019.*

Variables		Frequency	Percent
Type Of Injury Perceived	Abrasion	140	35.3
	Piercing/Cut	93	22.7
	Muscular Pain	71	18
	Bone Fracture	46	11.5
	Sprain/strain	39	10.5
	Permanent Disability	10	2
Type Of Injury Suffered	Abrasion	109	32.20
	Piercing/Cut	104	30.80
	Bone Fracture	46	13.60
	Sprain/Strain	34	10.10
	Muscular Pain	26	7.70
	Back Pain	19	5.60

Table 3: *preparedness for injury protection on PPE utilization and associated factors among construction workers in Addis Ababa, Ethiopia 2019.*

Variable		Frequency	Percent
Knows any PPE	Yes	174	84.5
	No	32	15.5
Safety training	Yes	65	31.6
	No	141	68.4
Safety Brief	Yes	73	35.4
	No	133	64.6

Table 4: *Bivariate and multivariate regression of variables on PPE utilization and associated factor among building construction workers in Addis Ababa, Ethiopia 2019.*

<i>Variable</i>		PPE use		<i>COR (95%CI)</i>	<i>P Value</i>	<i>AOR (95%CI)</i>	<i>P Value</i>
		Yes	No				
Age	<=30	73	109	2.009(0.761,5.302)	0.159	0.896(0.237,3.392)	0.871
	>30	6	18	1		1	
Level Of Education	Illiterate	18	44	1.731(0.756,3.966)	0.194	2.37(0.8,7.02)	0.120
	Primary	20	34	1.204(0.524,2.765)	0.661	1.652(0.56,4.869)	0.363
	Secondary	24	25	0.738(0.320,1.703)	0.476	1.011(0.344,2.973)	0.985
	> College	17	24	1		1	
Term Of Employment	Permanent	18	41	0.619(0.325,1.179)	0.144	0.718(0.306,1.686)	0.446
	Tempory	61	86	1		1	
Year Of Experience	< 1 Yr.	45	78	1		1	
	1 - 5 Yr.	24	39	0.406(0.043,3.855)	0.433	0.545(0.42,7.025)	0.642
	6 -10 Yr.	9	6	0.167(0.015,1.879)	0.147	0.251(0.016,3.931)	0.325
	> 10 Yr.	1	4	0.433(0.047,3.997)	0.461	0.463(0.38,5.642)	0.546
Safety Training	Yes	36	29	2.829(1.543,5.189)	0.001	2.343(1.084,5.062)	0.030
	No	43	98	1		1	
PPE Use Training	yes	48	27	5.735(3.084,10.66)	0.000	4.821(2.263,10.272)	0.000
	No	31	100	1		1	
Perceives Any Injury	Yes	75	111	1		1	
	No	4	16	0.37(0.119,1.15)	0.086	0.863(0.204,3.642)	0.841
Suffer Injury	Yes	70	100	1		1	
	No	9	27	0.476(0.211,1.075)	0.074	0.768(0.261,2.265)	0.633
Knows Any PPE	Yes	74	100	1		1	
	No	5	27	0.250(0.92,0.681)	0.007	0.477(0.135,1.677)	0.248
Safety Brief Before Work	Yes	44	29	4.248(2.315,7.797)	0.000	4.156(1.921,8.988)	0.00
	No	35	98	1		1	
Enforcement ,Supervision	Yes	27	9	6.808(2.993,15.49)	0.000	5.04(1.938,13.106)	0.001
	No	52	118	1		1	

Figures

**Constructions sites under control of AA City administration cons. office
during the study period**

Figure 1

Sampling Procedure for PPE utilization and associated factors among Construction Workers in Addis Ababa 2019.

Figure 2

Status of PPE utilization among construction workers on the assessment of PPE utilization among construction workers in Addis Ababa, Ethiopia, 2019.

Figure 3

Specified reasons for not using PPE in construction sites and its frequency on PPE utilization and associated factor among construction workers in Addis Ababa, Ethiopia 2019.

Figure 4

The presence of pressure on PPE utilization among construction workers on PPE utilization and associated factor among construction workers in Addis Ababa, Ethiopia 2019.

Figure 5

Awareness on the cause of injury among construction workers on PPE utilization and associated factor among construction workers in Addis Ababa, Ethiopia 2019.